ORIGINAL ARTICLE

Delivery mode is associated with maternal mental health following childbirth

Sharon Dekel[1,2] · Tsachi Ein-Dor[3] · Zohar Berman[1,2] · Ida S. Barsoumian[1] · Sonika Agarwal[1] · Roger K. Pitman[1,2]

Abstract

Childbirth is a life-transforming event often followed by a time of heightened psychological vulnerability in the mother. There is a growing recognition of the importance of obstetrics aspects in maternal well-being with the way of labor potentially influencing psychological adjustment following parturition or failure thereof. Empirical scrutiny on the association between mode of delivery and postpartum well-being remains limited. We studied 685 women who were on average 3 months following childbirth and collected information concerning mode of delivery and pre- and postpartum mental health. Analysis of variance revealed that women who had cesarean section or vaginal instrumental delivery had higher somatization, obsessive compulsive, depression, and anxiety symptom levels than those who had natural or vaginal delivery as well as overall general distress, controlling for premorbid mental health, maternal age, education, primiparity, and medical complication in newborn. Women who underwent unplanned cesarean also had higher levels of childbirth-related PTSD symptoms excluding those with vaginal instrumental. The risk for endorsing psychiatric symptoms reflecting clinically relevant cases increased by twofold following unplanned cesarean and was threefold for probable childbirth-related PTSD. Maternal well-being following childbirth is associated with the experienced mode of delivery. Increasing awareness in routine care of the implications of operative delivery and obstetric interventions in delivery on a woman's mental health is needed. Screening at-risk women could improve the quality of care and prevent enduring symptoms. Research is warranted on the psychological and biological factors implicated in the mode of delivery and their role in postpartum adjustment.

Keywords Delivery mode · Childbirth · Mental health · Postpartum depression · Postpartum PTSD

Introduction

Childbirth is a complex event. Although viewed as uniformly happy, the rapid psychophysiological changes during birth may render it stressogenic. About 85% of postpartum women experience some mood disturbance, which is usually short-lived and remits spontaneously (O'Hara et al. 1990; Reck et al. 2009). A considerable number of women are likely to suffer from more enduring symptoms subsequently manifested in various postpartum psychiatric illnesses (Campbell et al. 1992; O'Hara et al. 1991). While postpartum depression (PPD) is the most documented complication of childbirth (Dekel et al. 2019), current research shows other conditions can also occur, including anxiety and posttraumatic stress–related disorders (Ayers and Ford 2016; Dekel et al. 2017). Psychological disturbance in the mother can impair her functioning and well-being but also the mother-infant bond (Dekel et al. 2018; Moehler et al. 2006) and adversely modify the developmental trajectory of the offspring (Cicchetti et al. 1998; Petterson and Albers 2001). Postpartum psychopathology increases vulnerability to mental illness in the adult offspring (Netsi et al. 2018; Yehuda et al. 2008). These considerations raise the specter of intergenerational disease transmission with heavy public health costs.

In accord with a diathesis-stress model, individual characteristics must combine with an external stressor that is intense enough to trigger an illness (McKeever and Huff 2003). While premorbid (e.g., younger age, primiparity, history of mental illness) and peripartum factors (e.g., medical complications in

✉ Sharon Dekel
   sdekel@mgh.harvard.edu

1 Department of Psychiatry, Massachusetts General Hospital, Building 120- 2nd Avenue, Charlestown, MA 02129, USA

2 Harvard Medical School, Harvard University, 25 Shattuck St, Boston, MA 02115, USA

3 Interdisciplinary Center, Kanfei Nesharim, 4610101 Herzliya, Israel

the newborn) may increase risk for postpartum psychopathology (Andersen et al. 2012; Ayers et al. 2016), the possibility that the way of labor affects a woman's psychological state has received growing attention. It has been suggested that obstetrics interventions in delivery—determined for life-saving purpose for mother and child—may have a negative effect on a mother's well-being; however, empirical evidence remains inconclusive.

Existing studies document that cesarean delivery is associated with postpartum mental health disturbance mainly evident in PPD (Lobel and DeLuca, 2007). These findings may suggest a serious concern for obstetrics care, as cesarean rates are estimated at 32% in the USA, exceeding the 15% rate considered the highest acceptable by the World Health Organization (Betrán et al. 2016). Higher prevalence of PPD symptoms above the suggested clinical cutoff score has been noted among women who underwent operations in comparison to those who had delivered infants vaginally (Chang et al. 2015; Chen et al. 2017; Rauh et al. 2012). Lowered sense of control and violation of childbirth expectations as well as disrupted regulation of oxytocin secretion in birth has been hypothesized to lower maternal mood (Chen et al. 2017; Lobel and DeLuca 2007).

In contrast, a body of other studies reveals no evidence that cesarean delivery increases the risk for mood disturbance assessed as far as the first postpartum year. This has been reported in a meta-analysis of 24 studies with over 27,000 postpartum women (Carter et al. 2006). For example, Murray and Cartwright (1993) show that preexisting differences between women who have cesarean versus vaginal may account for the presumably negative affect of mode of delivery on maternal mental health. Post-delivery stressors that have to do with health complications in the newborn and are often seen in operative delivery may also account for the relationship (Villar et al. 2007).

Finally, a few studies suggest that cesarean delivery may actually protect from adverse postpartum psychological outcomes. Women undergoing vaginal delivery reported higher PPD symptoms than those who had a cesarean assessed several months post-birth (Chaaya et al. 2002, Olieman et al., 2017). This has been hypothesized to be due to prenatal preparation for surgery and increase support after birth.

An important factor to consider is the various psychiatric outcomes manifested in the postpartum period (Brockington 2004). Previous studies mainly focused on PPD and therefore less is known about the role of delivery mode in relation to anxiety and stress-related postpartum conditions. Moreover, existing research often examined postpartum outcomes by contrasting women following cesareans and vaginal deliveries (e.g., Mathisen et al. 2013; Sadat et al. 2014; Sword et al. 2011). Knowledge of postpartum mental health outcomes in relation to subtypes of delivery modes (i.e., planned vs. unplanned cesarean and vaginal vs. instrumental vaginal) (e.g.,

Rowlands and Redshaw 2012), which each may involve different birth experiences, is limited.

To this end, we studied a large sample of women in the first months following birth, including some women who endorsed psychiatric symptoms in the postpartum period. We focused our analysis on the question of whether women who undergo different mode of deliveries also differ in regard to their mental health state following parturition. And second, whether differences in postpartum mental health exist even after accounting for possible confounding factors.

Materials and methods

Participants

This study is part of a larger project on childbirth and psychological sequelae. Women who gave birth to a live baby in the last 6 months were recruited through web announcements on websites including postpartum-related sites (e.g., Postpartum Support) between November 2016 and April 2017. Exclusion criteria included stillbirth and being younger than 18 years of age. Women completed an anonymous survey in English concerning their childbirth and pre- and postpartum mental health. Partners Human Research Committee (PHRC) granted the project exemption (see, Dekel et al. 2018, for detailed information about the study sample).

Eight hundred forty-six women agreed to participate and among them, 94% met inclusion criteria ($N = 795$). We excluded a further 110 participants from the data set due to non-response on most measures, leaving a final sample of 685 women. This sample included women who on average were 31 years old ($SD = 4.80$) and 3 months postpartum ($SD = 1.5$). Around half were primiparas (56%). The majority had a planned pregnancy (74%), delivered at-term a healthy baby (79%), were also married (93%), had at least college education (71%), were middle class (median household income = $50,000–$99,000), and resided in North America (66%).

Measures

Postpartum psychiatric symptoms were assessed with the commonly used Brief Symptom Inventory (BSI) targeting 53 symptoms and comprising 9 symptom clusters (somatization, obsessive compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) (Derogatis 1993). The inventory measures symptom intensity during the past week on a 5-point scale (0–4). It has adequate properties (Derogatis 1993) and used in postpartum samples (Örün et al. 2013; Ross et al. 2003). Reliability for the symptoms clusters was good (α between 0.77 and 0.92). We defined probable clinical cases as a score

of 9 > = on at least two clusters (depression, anxiety, or obsessive compulsive) (Biggs et al. 2017). We calculated a single composite score of all items, i.e., the Global Severity Index (GSI), for global psychological distress.

Childbirth-related posttraumatic stress was assessed with the widely used PTSD checklist for DSM-5 (PCL-5; Weathers et al. 2013), with "recent childbirth" as the index event. This 20-item measures PTSD symptoms and their intensity over the past month on a 5-point scale (0–4). It has good psychometrics (Blevins et al. 2015) and has been used in postpartum samples (Scheepstra et al. 2017; Stramrood and Slade 2017; Van Heumen et al. 2018). In this study, reliability was high ($\alpha = 0.95$). Conforming to DSM-5 symptom criteria (Diagnostic Statistical Manual of Mental Disorders, 5th ed, American Psychiatric Association 2013), probable childbirth-related PTSD was defined as symptom intensity of 2 > = to include at least 1 intrusion, 1 avoidance, 2 alterations in cognitions and mood, and 2 reactivity and hyperarousal.

Childbirth and demographic information was assessed using single items for the purpose of this study, including age, education, income, primiparity, gestation week, mode of delivery (natural delivery, i.e., without routine medical interventions including anesthesia; vaginal delivery; instrumental vaginal delivery, i.e., forceps-assisted delivery or vacuum-assisted delivery; planned or unplanned cesarean section), health complications in newborn resulting in neonatal intensive care (NICU) admission, and mental health problems before childbirth (mainly depression, anxiety, PTSD).

Statistical analysis

The pattern of missing data was estimated using Little's missing completely at random (MCAR) test and handled using multiple imputations (Rubin 2009) where all variables were included. Analyses were performed with SPSS v.21. Differences in postpartum symptom severity by delivery mode were estimated using a multivariate analysis of variance (MANOVA) and an analysis of variance (ANOVA). We also employed multivariate analysis of covariate (MANCOVA) and analysis of covariance (ANCOVA) to assess the stability of these differences taking into account the contribution of age, primiparity (0 = no, 1 = yes), education level, general mental health problems before birth (0 = no, 1 = yes), premorbid depression (0 = no, 1 = yes), anxiety (0 = no, 1 = yes), and PTSD (PTSD; 0 = no, 1 = yes), PPD (0 = no, 1 = yes), other premorbid mental health conditions (0 = no, 1 = yes), and medical complications in newborn (0 = no, 1 = yes). Šidák post hoc analyses (Abdi 2007; Šidák 1967) were used to examine the source of significant differences. The MANOVA was followed by discriminant analysis (also known as canonical regression) to examine the relative difference between delivery groups by different symptom cluster. Differences in the prevalence of estimated clinically relevant cases of

probable postpartum psychopathology and childbirth-related PTSD was examined by chi-square test for independence of measures, with Fisher's exact test to estimate significance and relative risk to estimate effect size.

Results

8.6% of the data were missing; out of the total of 685 participants, 99.4% had 1 to 20 items missing ($Mdn = 4$ items; 0.6% of the sample had complete data in all variables). Little's MCAR test had indicated that the data were missing completely at random, $\chi^2(2654) = 1642.80$, $p = 1.00$. To handle missing data, we used multiple imputations (Rubin 2009) with 10 imputed datasets.

Differences in mental health outcomes symptoms by mode of delivery

22.2% ($N = 152$) of the participants had natural delivery (ND), 34.7% ($N = 238$) vaginal delivery (VD), 7.2% ($N = 49$) instrumental vaginal delivery (IVD), 19.3% ($N = 132$) planned cesarean section (PCS), and 16.6% ($N = 114$) unplanned cesarean section (UPCS). Groups differed on primiparity ($\chi^2(4) = 66.51$, $p < .001$), newborn complications ($\chi^2(4) = 33.70$, $p < .001$), and age ($F_{(4,680)} = 4.17$, $p = .002$).

We examined differences in psychopathology-related symptoms (somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism) severity by delivery mode by employing MANOVA followed by discriminant analysis (Table 1).

The analyses revealed a significant multivariate difference between delivery modes, *Pillai's T* = .13, $F_{(36, 2700)} = 2.48$, $p < .0001$, such that delivery mode accounted for 13% of the variance in symptoms severity. The analysis highlighted two discriminant functions: (1) women who had UPCS, PCS, or IVD were higher on somatization, obsessive compulsive, depression, anxiety, and hostility than women who had VD or ND; and (2) women who had UPCS tended to be higher than the other groups on psychoticism and paranoid ideation (nonsignificant trend) (Fig. 1).

We examined the stability of these patterns using MANCOVA adjusting the analysis based on the contribution of maternal age, primiparity, years of education, premorbid general mental health problems, premorbid mental health, and medical complications in newborn. The analysis revealed similar results.

We further conducted an additional one-way ANOVA with Sidak post hoc analysis to examine differences in childbirth-related PTSD symptoms severity by delivery mode, which revealed significant results, $F_{(4, 680)} = 13.11$, $p < .0001$, $\eta^2 = .07$. Women who had UPCS ($M = 30.77$, $SD = 19.74$)

Table 1 Means, standard deviations, univariate statistics, and effect sizes for differences in postpartum psychopathology-related symptoms severity by delivery mode

	Natural		Vaginal		Assisted		Planned cesarean		Unplanned cesarean		$F_{(4, 680)}$	η^2_p
	M	SD	M	SD	M	SD	M	SD	M	SD		
Somatization	0.54[b]	0.68	0.66[b, c]	0.67	0.90[c]	0.77	0.87[c]	0.67	0.93[a, c]	0.87	7.42***	.042
Obsessive compulsive	1.02[b]	1.02	1.30	1.04	1.29	1.06	1.31	1.12	1.61[a]	1.17	4.72***	.027
Interpersonal sensitivity	0.99[b]	1.00	1.27[b]	1.10	1.30	1.19	1.28	1.11	1.66[a]	1.28	5.78***	.033
Depression	0.95[b]	0.96	1.18[b]	1.04	1.30	1.19	1.18[b]	1.08	1.61[a]	1.21	6.39***	.036
Anxiety	0.77[b]	0.86	1.04[b, c]	0.97	1.04	0.92	1.16[c]	0.98	1.37[a]	1.03	6.72***	.038
Hostility	0.72[b]	0.76	0.91	0.80	0.88	0.87	0.99[a]	0.87	1.09[a]	0.90	3.82**	.022
Phobic anxiety	0.60[b]	0.76	0.70[b]	0.78	0.64	0.74	0.75	0.79	1.00[a]	0.96	4.50***	0.26
Paranoid ideation	0.68	0.79	0.76	0.78	0.59	0.79	0.79	0.84	0.94	0.96	2.12	0.12
Psychoticism	0.63[b]	0.75	0.80[b]	0.78	0.78[b]	0.73	0.85[b]	0.80	1.18[a]	0.93	7.83***	0.44

*$p < .05$, **$p < .05$, ***$p < .001$. η^2_p, partial eta-squared. Means with different superscript letters are significantly different at $p < .05$ based on Sidak adjustment. For example, the unplanned cesarean group had higher levels of depression compared with all the other groups (except for the planned cesarean group)

had higher PTSD symptom levels than women who did not have UPCS (PCS, $M = 23.01$, $SD = 16.89$; VD, $M = 19.27$, $SD = 17.23$; ND, $M = 16.23$, $SD = 16.95$), excluding the group of women who had VID ($M = 25.04$, $SD = 16.90$). Additionally, women who had VID or PCS had higher symptom levels than women who had ND or VD.

An ANCOVA controlling for the contribution of the factors noted above found slightly different results: women who had gone UPCS had higher PTSD symptoms levels than all any others excluding those who had VID, but there were no significant differences between VID and PCS and the other groups.

Finally, we examined differences between the groups in regard to overall distress using one-way ANOVA with Sidak

post hoc analysis. The analysis was significant, $F_{(4, 680)} = 7.07$, $p < .001$, $\eta^2 = .04$. Women who had UPCS ($M = 1.28$, $SD = 0.88$) were higher on GSI than women who had ND ($M = 0.77$, $SD = 0.74$) and VD ($M = 0.96$, $SD = 0.75$); women who had PCS ($M = 1.03$, $SD = 0.78$) were higher on GSI than women who had ND ($M = 0.77$, $SD = 0.74$).

Differences in the prevalence of estimated postpartum psychopathology and PTSD

We examined differences in the prevalence of endorsing clinical relevant postpartum cases (based on symptom severity) and probable childbirth-related PTSD. To this end, we

Fig. 1 Canonical discriminant functions analysis for examining the differences in postpartum psychopathology-related symptoms severity by delivery mode
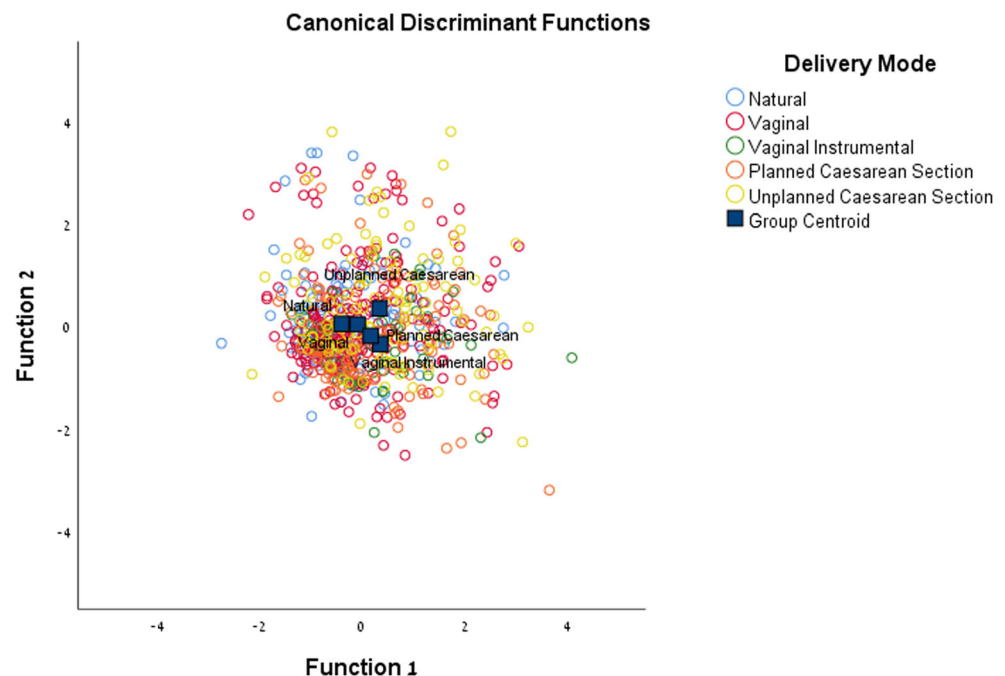
conducted a series of chi-square tests for independence of measures with Fisher's exact test for assessing the significance and relative risk scores for examining the relative risk of women who had UPCS for probable postpartum psychopathology and childbirth-PTSD in comparison to the rests. Results are summarized in Table 2.

The analyses indicated that women who had UPCS are 2.13 times more likely to endorse clinical symptoms than women who had ND, and 1.4 times more likely than women who had VD. Regarding childbirth-related PTSD, we found that women who had UPCS are 3.3 times more likely to endorse probable childbirth-related PTSD than women who had ND, 2.8 times more than women who had VD, and 2.37 times more at risk than women who had PCS.

Discussion

There is a controversy on whether the way of labor affects the psychological adjustment of women following childbirth. To address this issue, we studied women who had undergone different modes of delivery and compared their well-being in the first postpartum months on various psychiatric outcomes, including symptoms of depression, anxiety, psychosis, PTSD, and general distress. To better capture the association between mode of delivery and subsequent psychological adjustment, we controlled for the influence of premorbid factors which may affect postpartum adjustment (Guintivano et al. 2018), such as a woman's mental health before childbirth, primiparity, and maternal age as well as medical complications in the newborn.

Here, we document across a range of psychiatric outcomes that the mode of delivery is implicated in a woman's postpartum mental state. Women who had obstetric interventions (i.e., cesarean or instrumental vaginal) had higher psychological distress following childbirth than women who had natural or vaginal delivery. Poorer psychological health was not limited to depression symptoms but rather obstetric interventions were related to somatization, obsessive compulsive, anxiety-related, and hostility symptoms. We also found that having an unplanned cesarean increases a woman's vulnerability to suffer from clinically relevant psychiatric problems and probable PTSD evoked by childbirth by as much as three folds, suggesting that a stressogenic childbirth can pose significant threat to maternal well-being.

Cesarean sections have become increasingly common in developed and developing countries. Our findings support recommendations of the American College of Obstetricians and Gynecologists (ACOG) to minimize any unnecessary obstetric intervention in birth (American College of Obstetricians and Gynecologists 2017). Previous studies document increased risk following cesareans for severe maternal morbidities, complications in newborn medical health (Castillo-Ruiz et al. 2018; Zanardo et al. 2010), and also risk for complications in psychologically derived factors such as maternal bonding (Rowe-Murray and Fisher 2001). Increased psychological vulnerability following operative delivery may in part account for these negative outcomes.

It has been hypothesized that cesarean section involves disruption of the normal labor physiology as well as the hormonal environment to include oxytocin deficiency (Swain et al. 2008). Other related hormones that are mediators of stress reactivity, which peak in labor, such as cortisol (Stjernholm et al. 2016), could be dysregulated in cesarean delivery. A proper hormonal environment which promotes delivery and maternal bonding (Feldman et al. 2007) and mood (Jobst et al. 2016) may facilitate adaptive coping in the wake of the childbirth stressor, and disruption may result in risk for mental health problems, although other biological and psychological factors are likely at work (Dekel et al. 2017; Eckerdal et al. 2018).

The heightened risk of clinically relevant psychiatric symptoms following unplanned cesarean is worth noting. Prevalence of childbirth-related PTSD symptoms at a clinical level was evident in more than one out of three women. Although not all individuals with clinically relevant PTSD

Table 2 Prevalence of childbirth-related PTSD and psychopathology endorsement by delivery mode

	Childbirth-related PTSD			Postpartum psychopathology		
	%	RR	χ^2	%	RR	χ^2
Natural	12.5	3.30 (2.05, 5.30)	43.01***	21.1	2.13 (1.47, 3.07)	17.06**
Vaginal	14.7	2.80 (1.92, 4.08)		31.9	1.40 (1.06, 1.85)	
Assisted vaginal	24.5	1.68 (0.98, 2.88)		30.6	1.46 (0.91, 2.33)	
Planned cesarean	17.4	2.37 (1.54, 3.64)		33.3	1.34 (0.98, 1.84)	
Unplanned cesarean	41.2			44.7		

Childbirth-related PTSD refers to endorsement of probable PTSD in accord with DSM-5 symptom criteria. Postpartum psychopathology refers to endorsement of depression, anxiety or obsessive compulsive symptoms. *RR*, relative risk with unplanned cesarean as the reference group; 95% confidence interval for RR are presented in parenthesis

$**p < .01$, $***p < .001$

symptoms are likely to meet a PTSD diagnosis, sub-clinical PTSD may interfere with functioning (Marshall et al. 2001) and childbirth-related PTSD may interfere with maternal attachment (Davies et al. 2008; Dekel et al. 2018). A dose-response model underlies PTSD and posits a relationship between event magnitude and clinical outcome (Wyler et al. 1971). Accordingly, the increased risk for probable childbirth-related PTSD among women undergoing unplanned cesarean as others (Ryding et al. 1998; Söderquist et al. 2009), and we show here may reflect the magnitude of psychological and biological stressors. These may pertain to perceived (subjective) traumatic appraisal of the birth and acute disruption in biological processes accompanying natural birth.

Several limitations in this study should be noted. The cross-sectional study design does not allow cause and effect conclusions. While we obtained mental health assessment on average around 3 months postpartum—when symptoms become stable—ideally, we would conduct repeated assessments and collect birth information using medical records. We measured psychiatric symptoms with well-validated measures but did not include a clinical diagnostic assessment. Although we controlled for several factors to capture the link between mode of delivery and mental health, other factors may have been overlooked. Our sample, though large in size, was based on an internet sample. Incidences of clinical relevant cases are likely to be higher than in the community.

In conclusion, the experienced mode of delivery appears to have an important role in maternal mental health as assessed in a large sample of women three months following childbirth. In contrast to having a vaginal delivery, obstetric interventions are associated with psychological distress in the mother, and clinically relevant psychiatry-related cases are highly increased following an unplanned cesarean section. Our findings support a holistic approach in perinatal care taking into account also psychological factors when determining obstetrics decisions and benefit vs. risk ratio concerning mother's health. Monitoring at-risk women following parturition and implementing preventive interventions to lower the rates of postpartum psychological liability is warranted.

Compliance with ethical standards

Conflict of interest   The authors declare that they have no conflict of interest.

Ethical approval   All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Partners (Massachusetts General Hospital) Human Research Committee granted this study exemption.

Informed consent   This study entailed an anonymous online survey, no personal identifiable information was collected. Participants were informed that by agreeing to complete the study survey, they are implying their consent to participate in the study.

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